An 8-year, high-resolution reanalysis of atmospheric CO_2 mixing ratios based on OCO-2 and GOSAT-ACOS retrievals
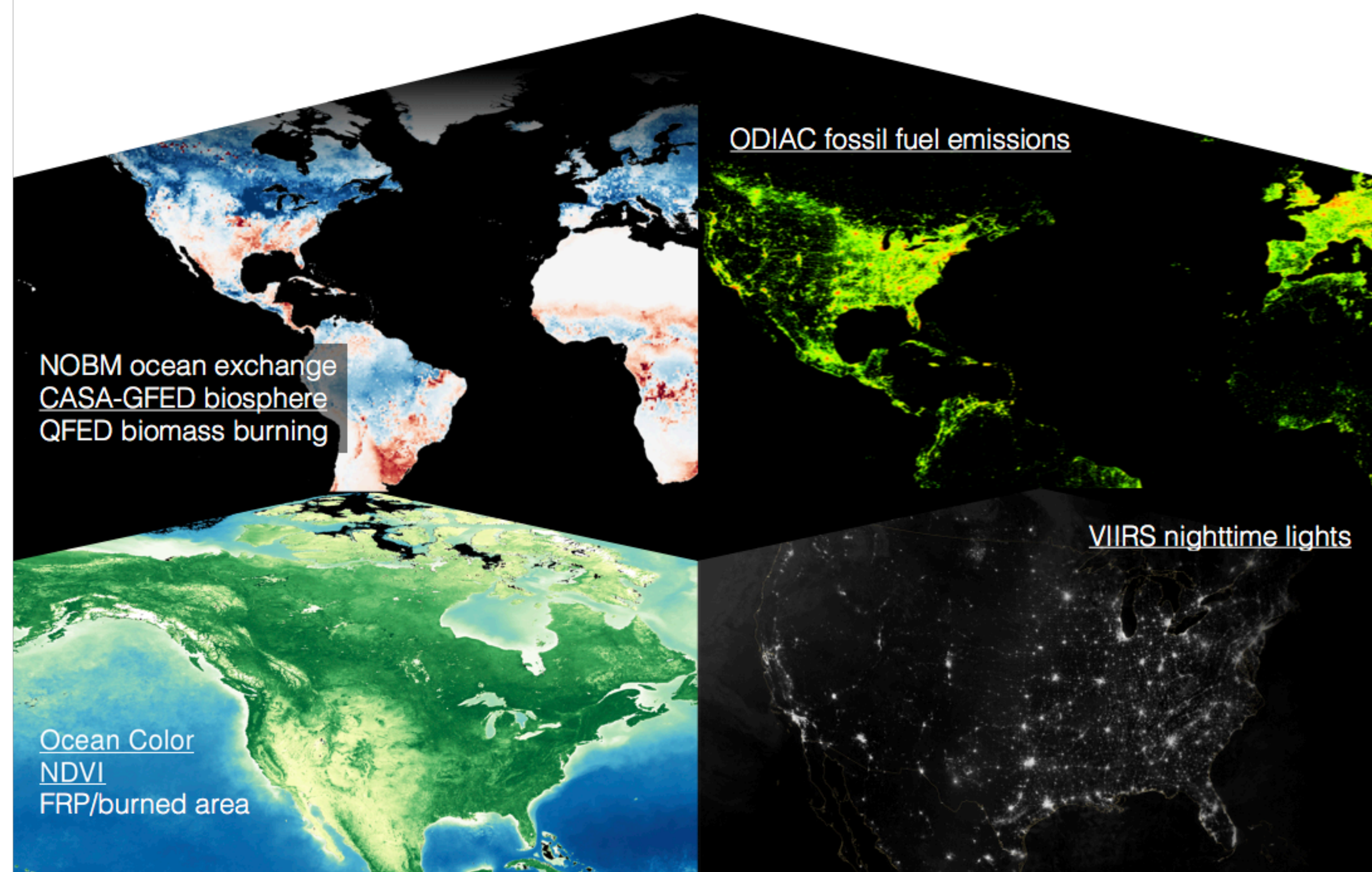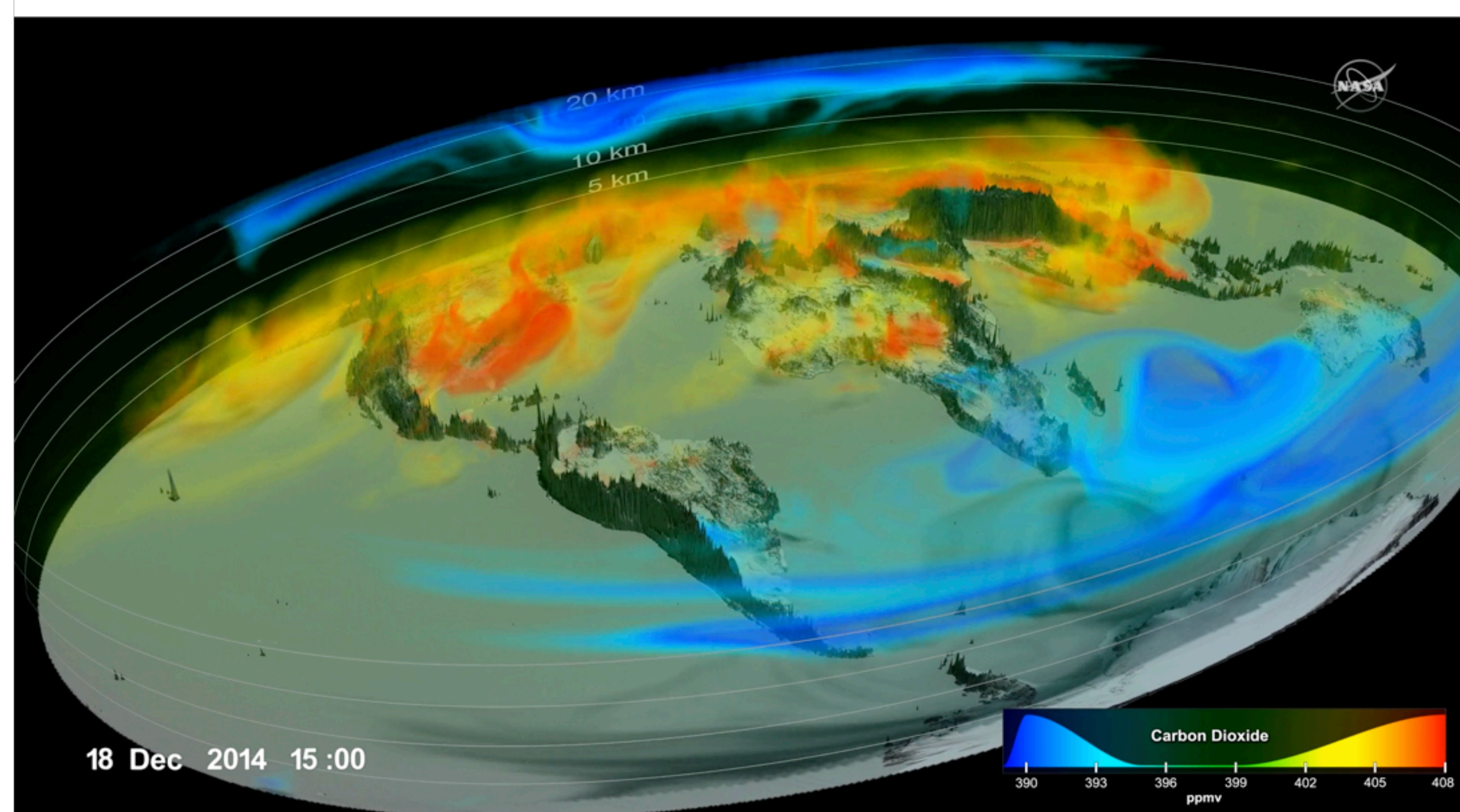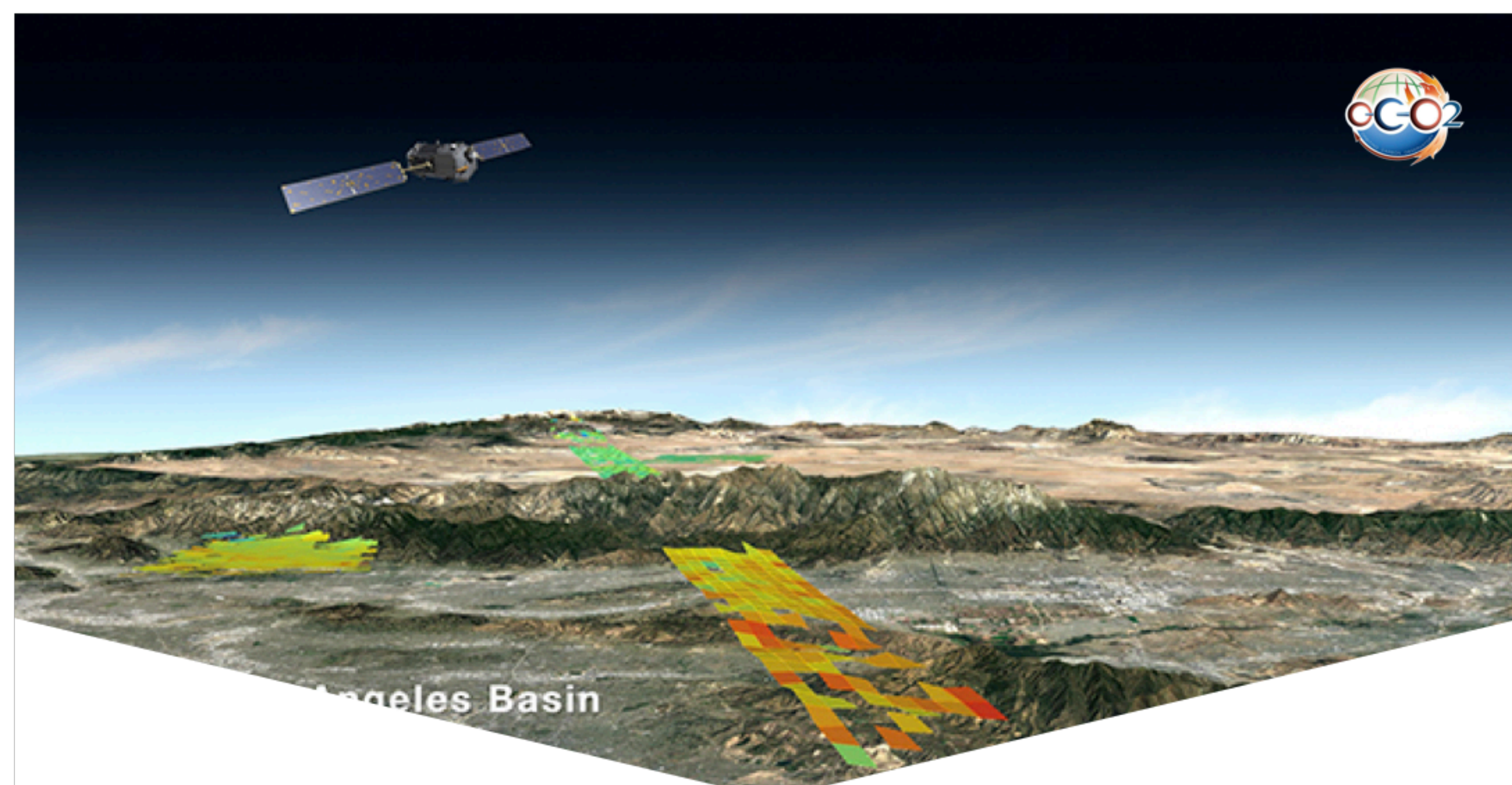
B. Weir[1,2], A. Chatterjee[1,2], L.E. Ott[2], and S. Pawson[2]

1) USRA/GESTAR, 2) NASA GSFC/GMAO

USRA
GMAO
Global Modeling & Assimilation Office

A33G-2451

The NASA GMAO reanalysis blends OCO-2 and GOSAT-ACOS retrievals (top) with GEOS model predictions (bottom) to estimate the full 3D state of CO_2 every 3 hours (middle).

*This poster describes monthly **atmospheric growth rates** derived from the reanalysis and **an application to aircraft data** with the potential to aid bias correction.*
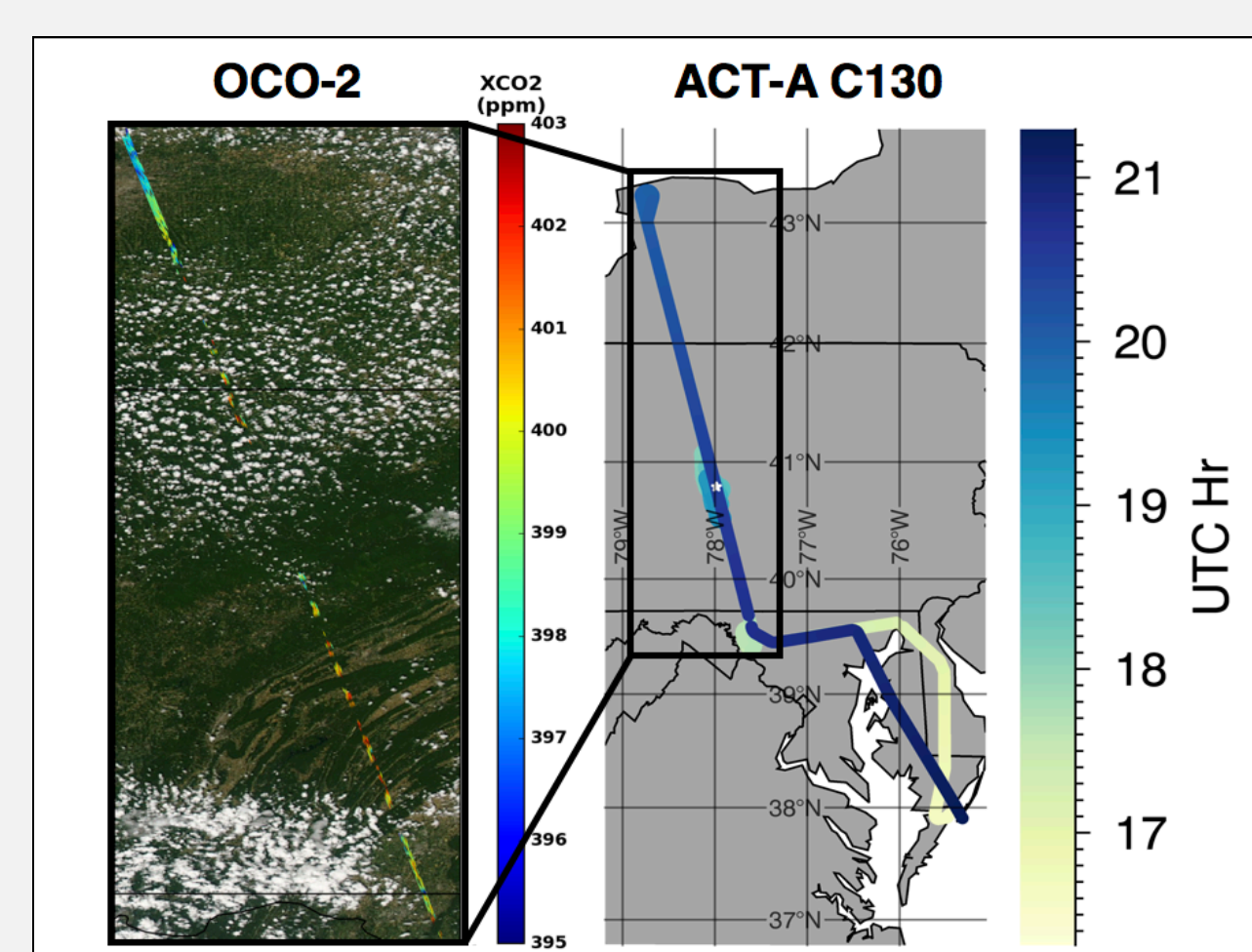

Angeles Basin

18 Dec 2014 15:00

Carbon Dioxide
390 393 396 399 402 405 408
ppmv

ODIAC fossil fuel emissions

NOBM ocean exchange
CASA-GFED biosphere
QFED biomass burning

VIIRS nighttime lights

Ocean Color
NDVI
FRP/burned area

Fig 1. Global average mixing ratios from (blue) GEOS with no assimilation and (green) reanalysis of GOSAT-ACOS data.
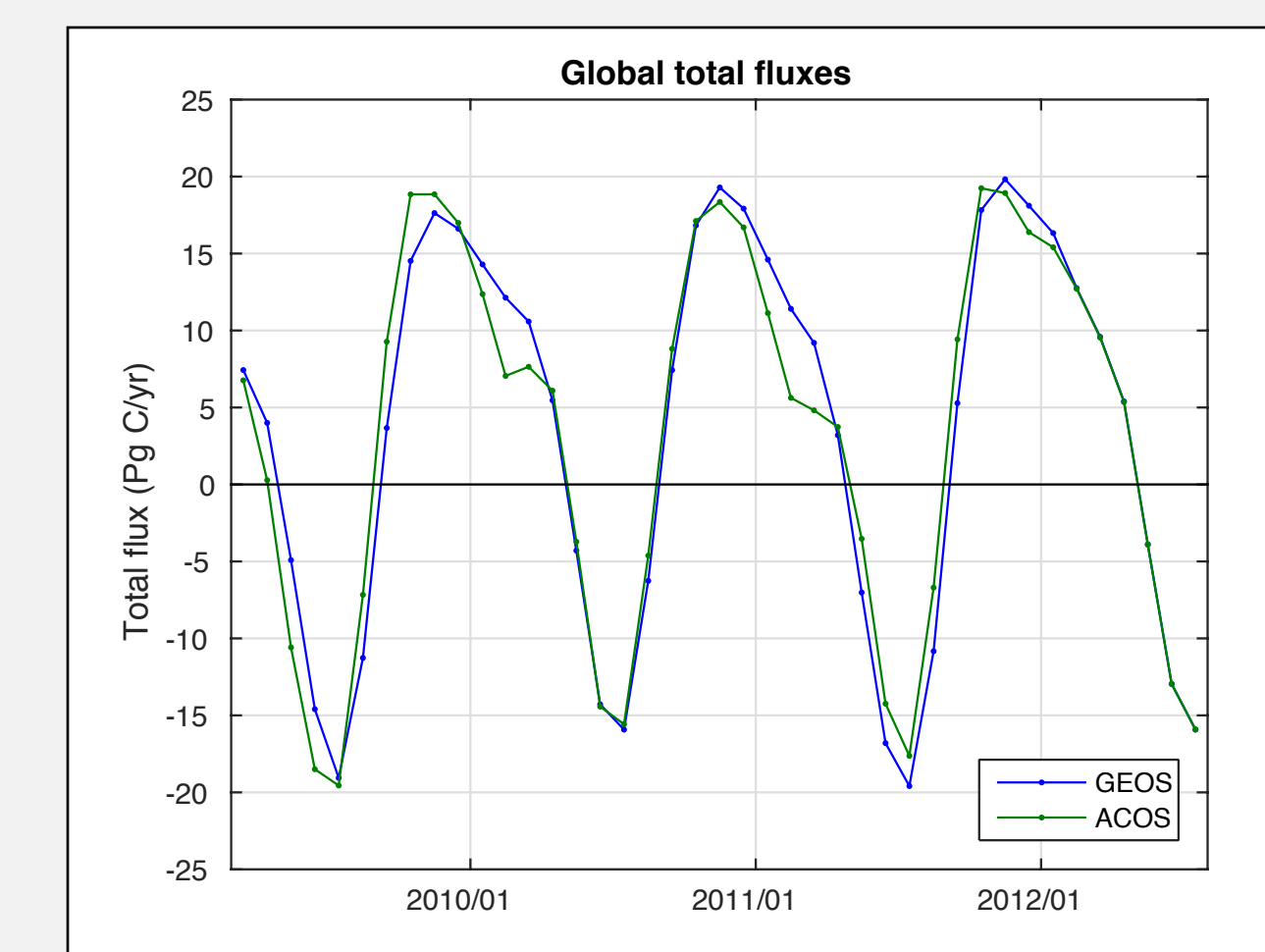
Fig 2. Global total fluxes computed as the change in monthly means from Fig 1. Note the change in Jan. thru Mar.

Atmospheric growth rate

Since OCO-2 and GOSAT-ACOS observe the column integral of CO_2 and have a 16-day repeat cycle, they have the potential to better constrain atmospheric growth rates on sub-annual time scales than data restricted to the PBL. Here, we compute monthly growth rates and show that the **satellites suggest the model has too much outgassing in boreal winter**.

Fig 3. Same as Fig 1, but now with (red) reanalysis of OCO-2 data.

Fig 4. Same as Fig 2, but now with (red) reanalysis of OCO-2 data.

Fig 1. OCO-2 overpass and ACT flight path for 27 July 2016.
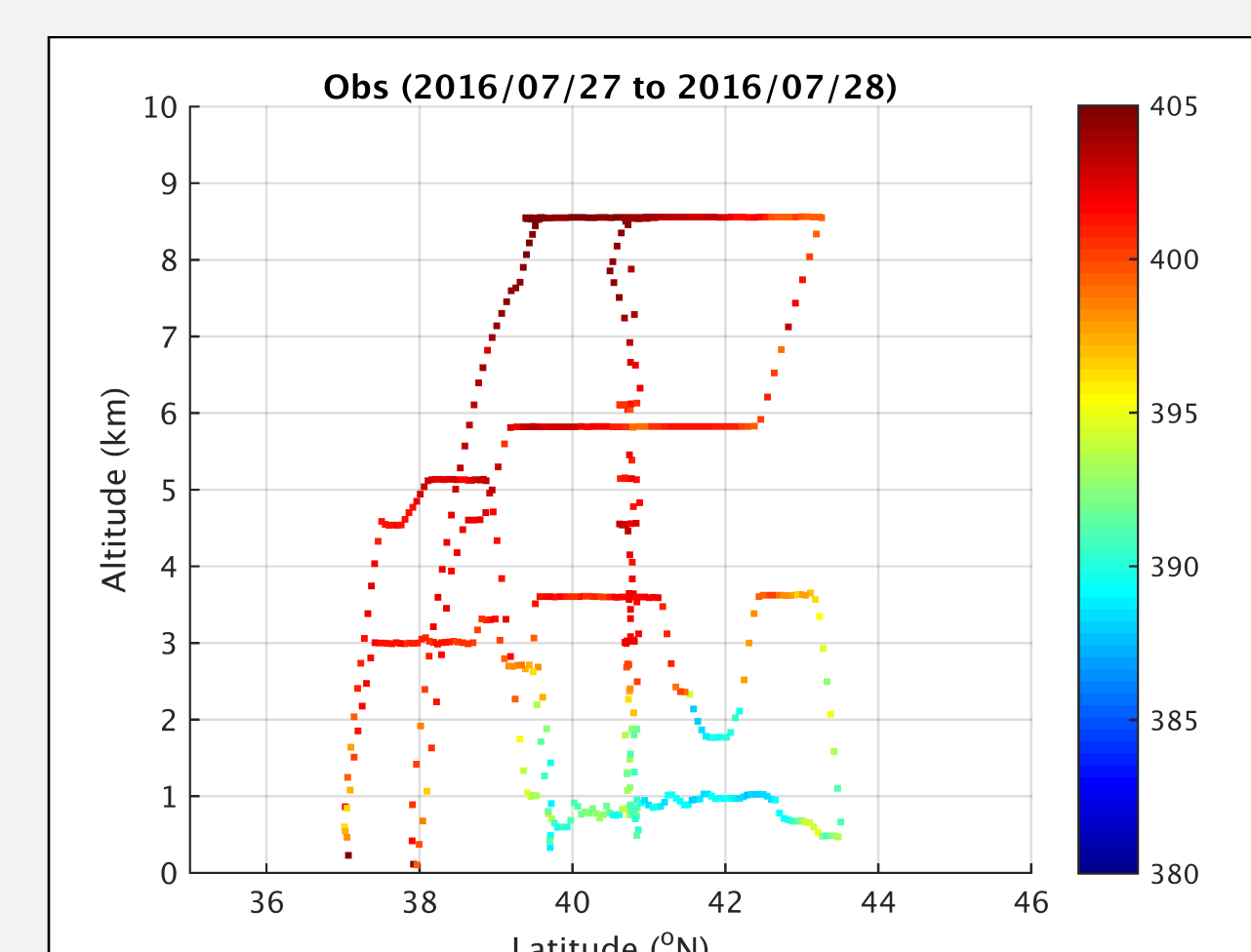
Fig 2. Measured CO_2 from ACT aircraft.

Aircraft-based analysis

Systematic model and satellite retrieval errors with coherent regional and seasonal patterns limit our ability to infer surface fluxes from satellite retrievals.

Here, we assimilate aircraft data from ACT-America into the GEOS model and compare the results to an OCO-2 overpass. **The assimilation indicates that the model PBL was too high. Overall, the mean difference with OCO-2 v7b is reduced from 0.59 ppm to 0.28 ppm.**
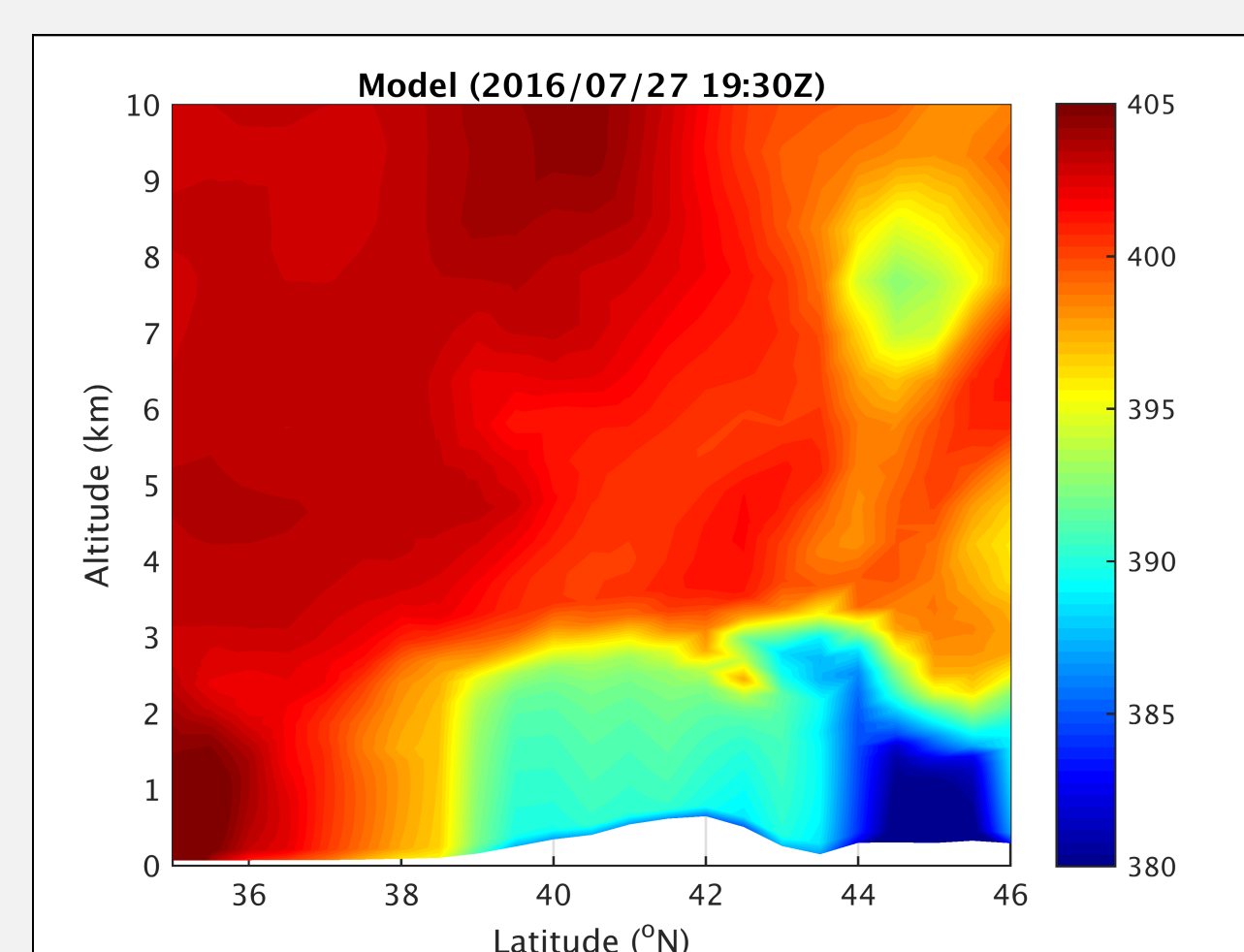

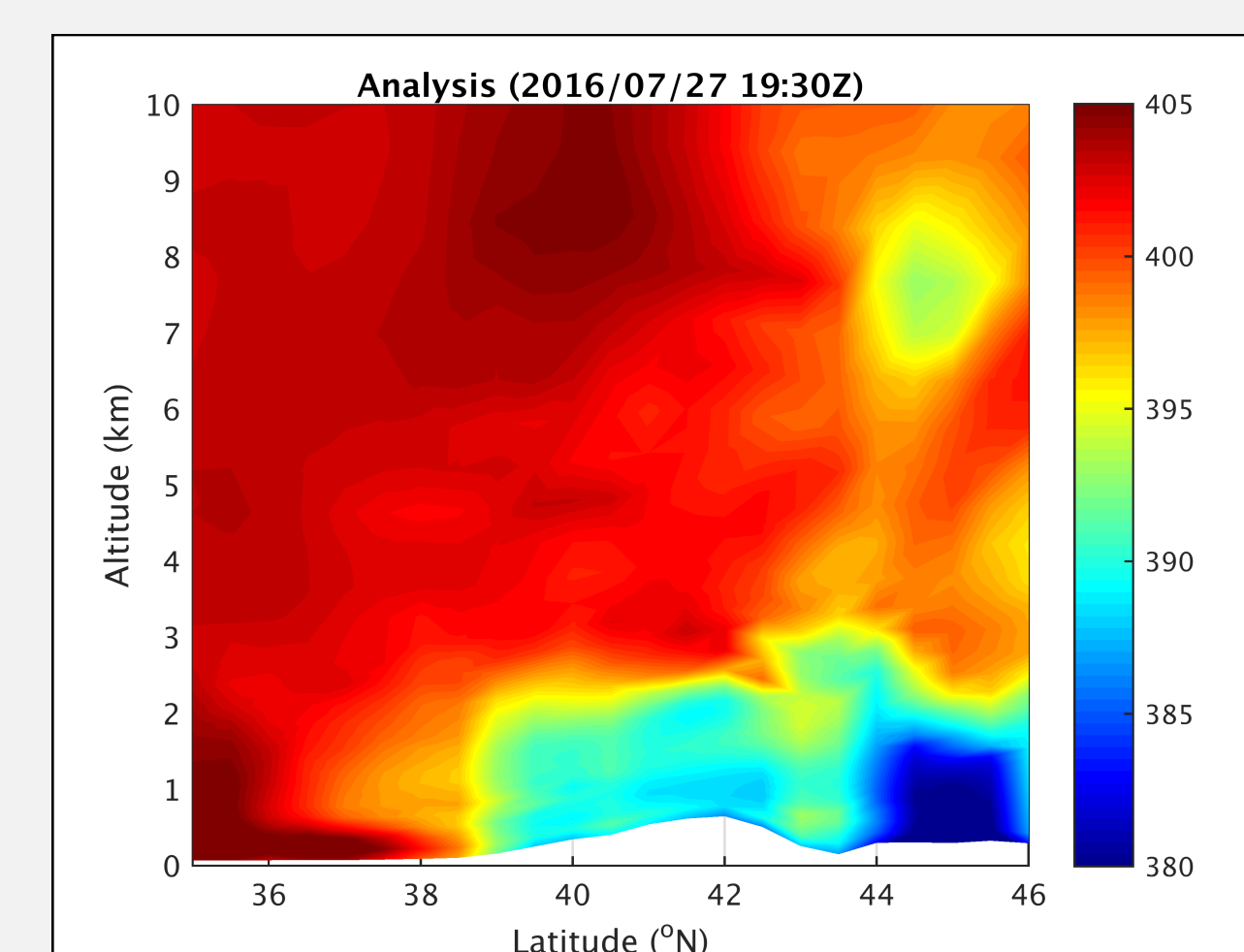**Fig 3.** GEOS forecasted values before assimilation.

Fig 4. Curtain for aircraft data assimilated into the GEOS model. Note the decrease in PBL height over 39° to 42°N from Fig 3.
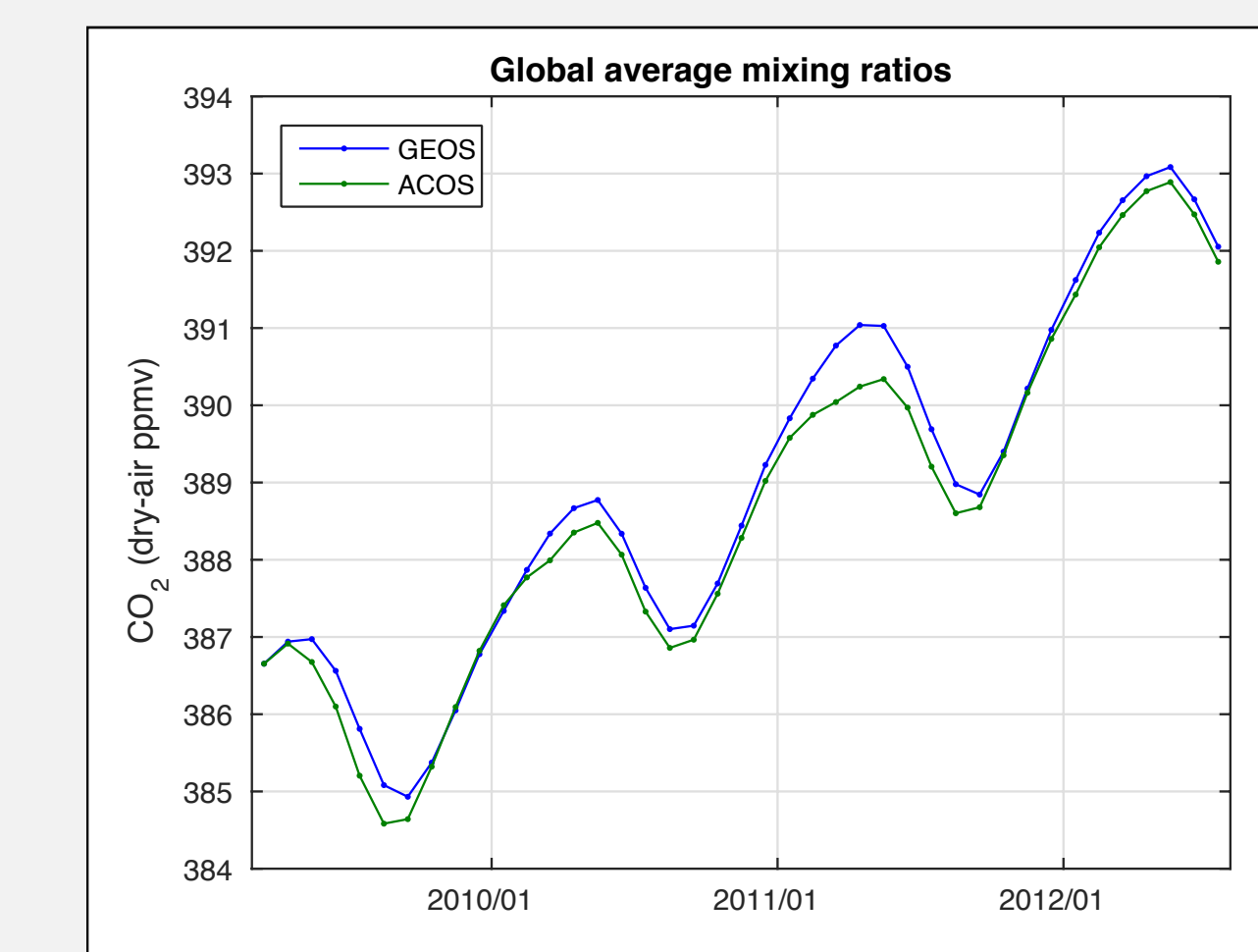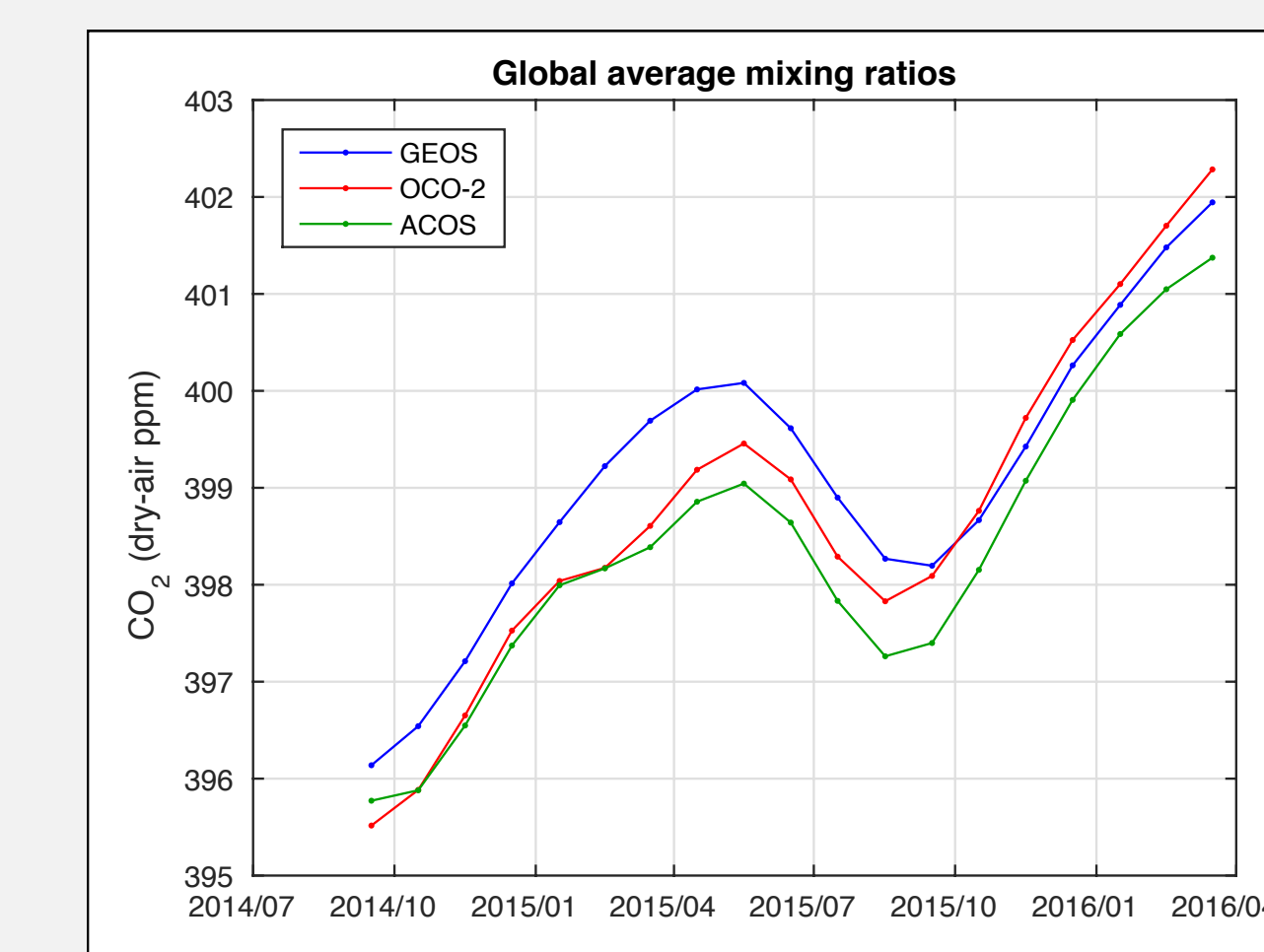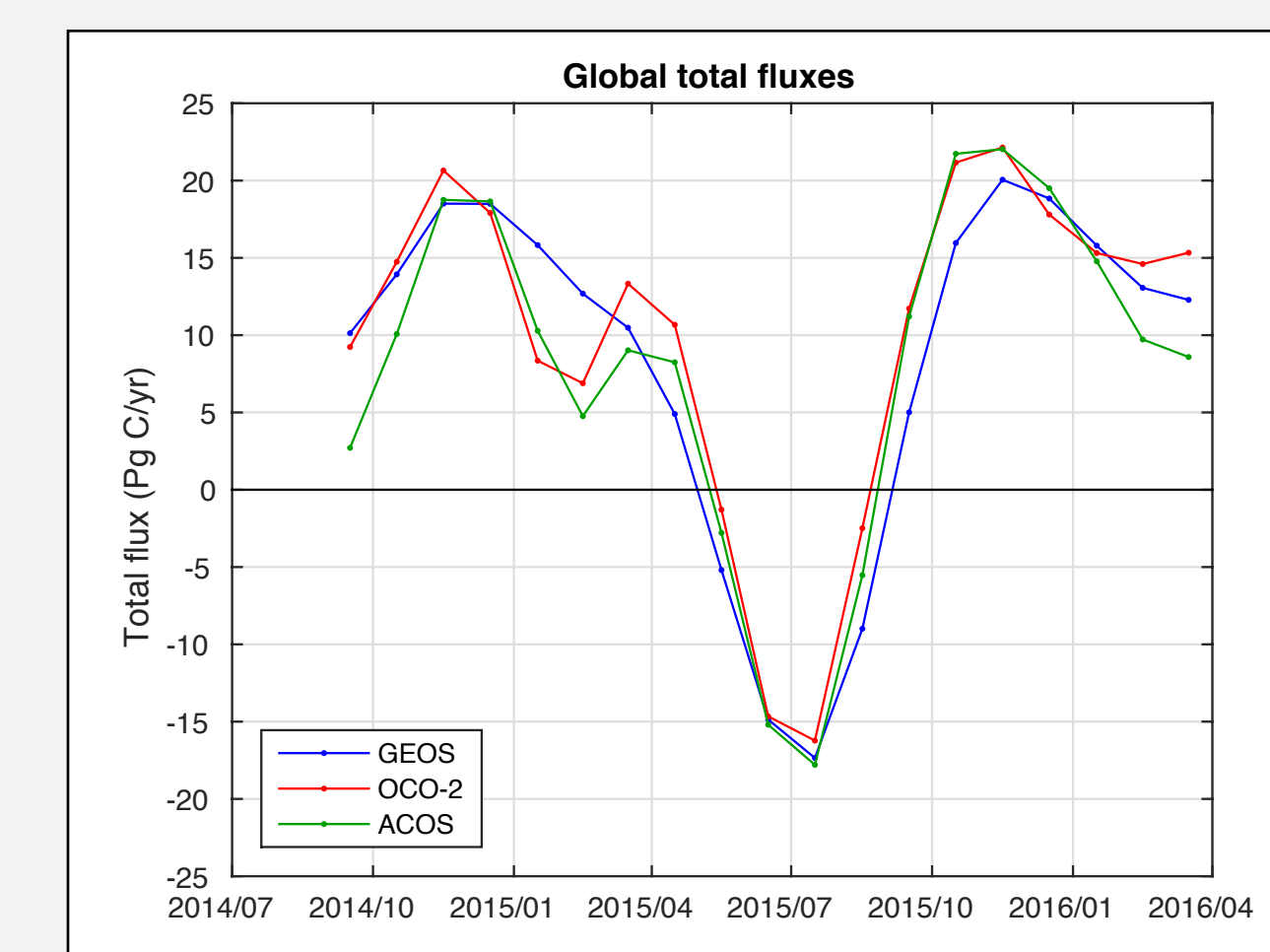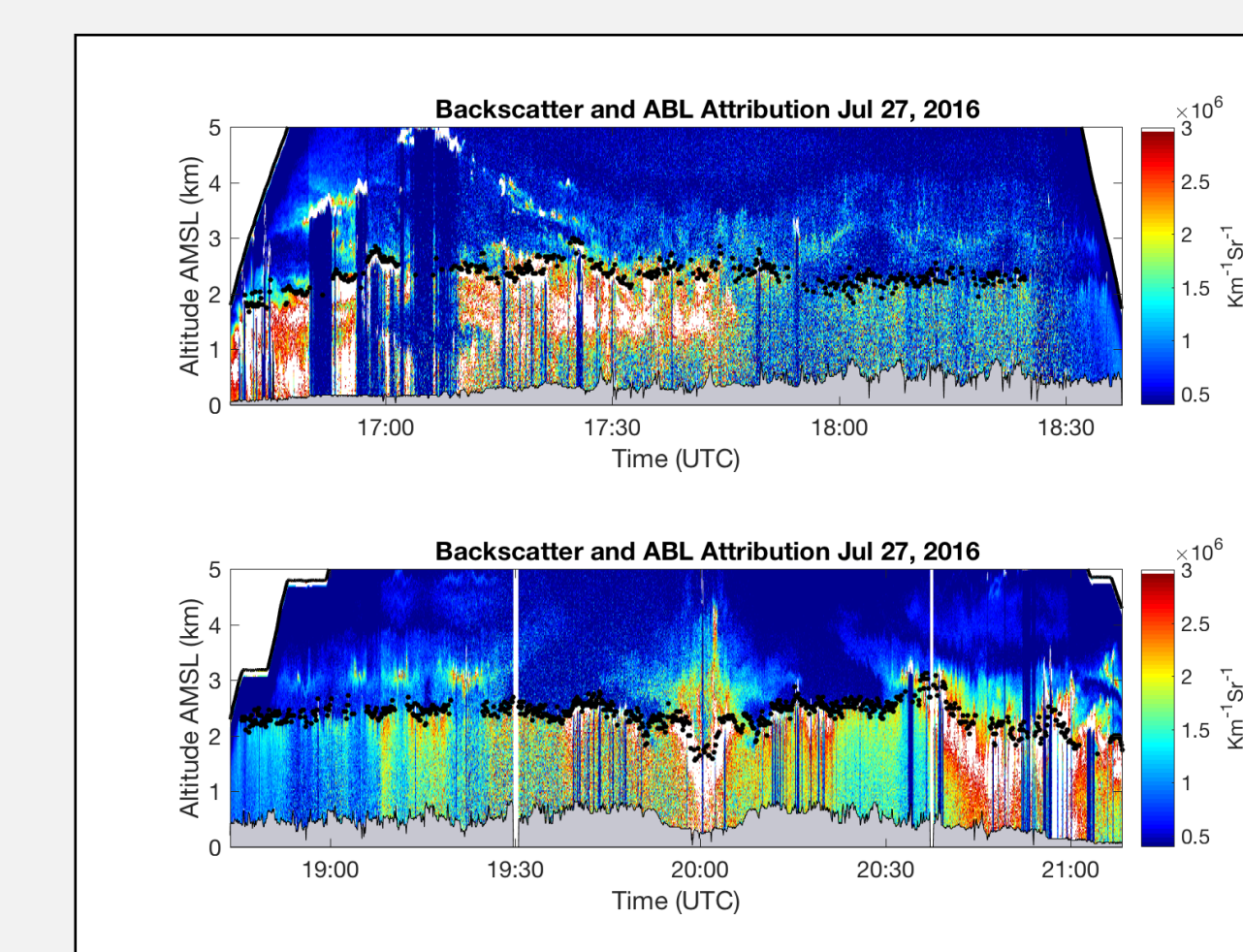
Fig 5. PBL height determined from Cloud Physics Lidar measurements. These heights are closer to those from Fig 4.

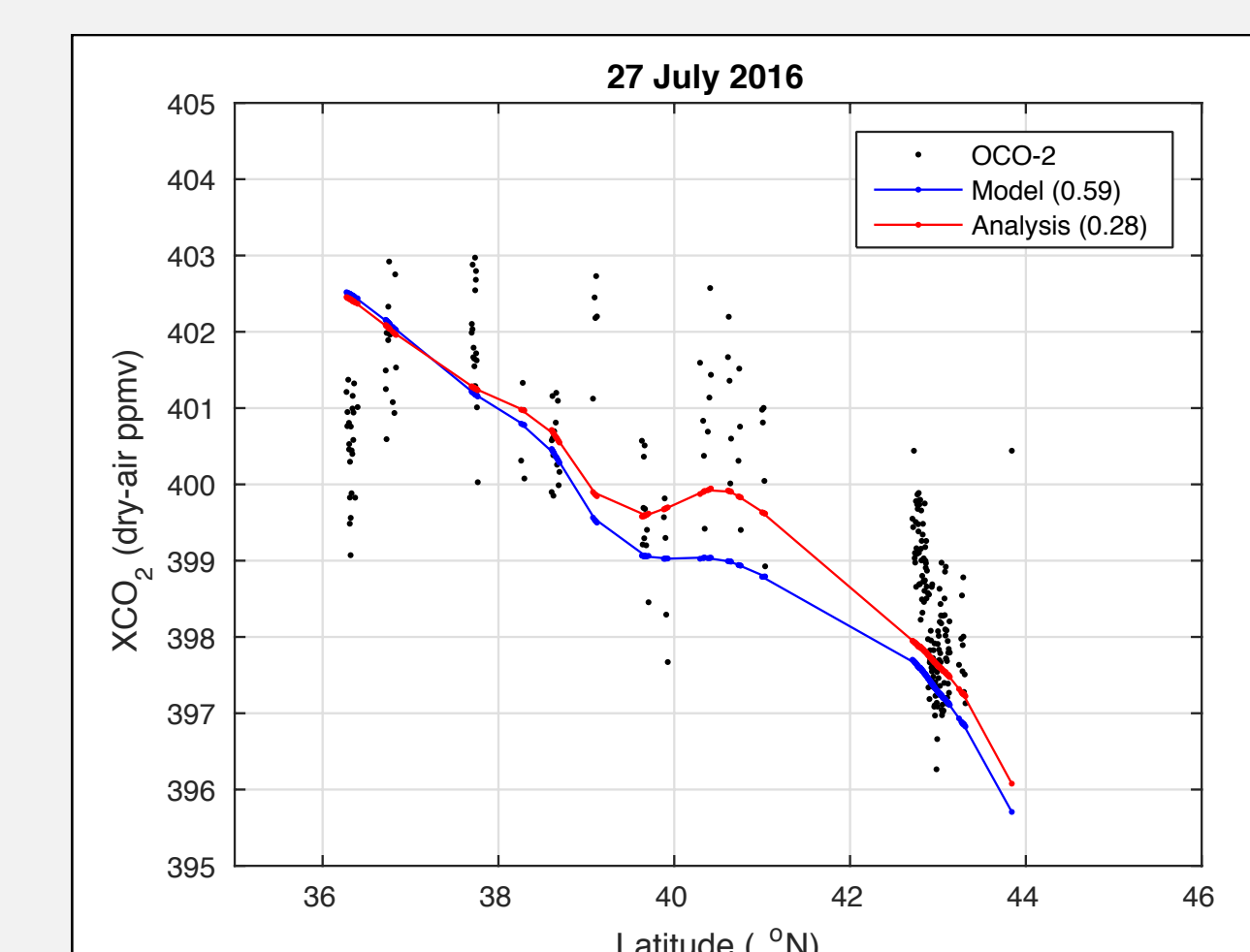**Fig 6.** Comparisons to column CO_2 (XCO2) from OCO-2 v7b. The analysis decreases the bias from 0.59 ppm to 0.28 ppm.